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A Need and a Concern: Reducing Fuels in the Riparian Areas of Southwestern Oregon

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RESEARCH SUPPORTING SOUND DECISIONS

A riparian ecosystem exemplifies the delicate balance between water and temperature, vegetation and life.
Credit: Chris Volpe.

A Need and a Concern: Reducing Fuels in the Riparian Areas of Southwestern Oregon

Summary

Sophisticated in composition but small in scale, a riparian area is a fertile ecosystem of various plant and animal species that occurs along watercourses or water bodies. In the Applegate River sub-basin of southwestern Oregon, there is little understanding on how prescribed fire may affect these areas. According to several studies, fire was historically an important component in some western riparian areas of both intermittent and perennial streams, burning at the same frequency and intensity as the associated upland areas. Due to a lack of supportive documentation and locally-pertinent data and the perception that the complex ecosystems may be compromised by thinning and burning, Medford District Bureau of Land Management land managers have avoided performing extensive fuel treatments in riparian areas.
As a result, it was the goal of researchers to address the information gaps and to study how fuel treatments affect fire behavior, vegetation, water, life, and overall diversity within the riparian area. By using a before-and-after approach and comparing riparian zones buffered from typical fuel treatments to those unbuffered from treatments, researchers were able to determine the effects and effectiveness of fuel treatments in riparian areas as well as to provide land managers with information and guidance necessary to inform future decisions.

Key Findings

In this study, fuel treatments in riparian areas:

- Can help sustain ecological integrity and support land management objectives.
- Show evidence that the post-treatment risk of severe wildfire was less throughout the basin when both riparian and upland areas were treated, as compared to when only the upland was treated.
- Lessen plant species diversity in unbuffered areas, but diversity rebounded after prescribed burning. Conversely, vegetation diversity in buffered areas experienced a continual decline.
- May affect the water temperature and amount of stream shade at certain sites.
- Result in no measurable adverse affects on macroinvertebrate groupings in either buffered or unbuffered basins.
- Had little to no impact on bird richness or nesting success between buffered and unbuffered basins, but did have short term effects on the reproductive success of ground and shrub nesting birds.
- Meet longer-term landscape level objectives to protect amphibian habitats, but can have site-specific negative effects on amphibian habitats if necessary precautions are not taken.

An enigmatic ecosystem

A microclimate may be meager in size, but it has an impressive capability to sustain life. One such microclimate is a riparian area, a small portion of the landscape that occupies the interface between aquatic and terrestrial ecosystems. Characteristically cool and moist, riparian areas are different from surrounding lands due to their unique soil and plant characteristics and rich diversity of species. Riparian areas may exist in any land use area, such as cropland or pastureland, but typical examples include wetlands, floodplains, lakeshores, and streambanks.

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Historically, fire was an essential, natural component of western riparian environments. Evidence shows that specific riparian areas within the Klamath Mountains Province of southwestern Oregon burned at similar frequencies as their associated upland areas. But over time, timber harvesting, replanting of tree stands, and fire exclusion have altered these dynamic ecological areas. In addition, due to a lack of information on fire effects and the perception that riparian areas are sensitive to disturbance, land managers have maintained a conservative management approach by using no-cut buffer strips to exclude these areas from fuel treatments.

Protecting the biodiversity and richness of riparian areas from unknown fire effects is imperative, however, the lack of fuel management treatments can lead to unnaturally high levels of fuel accumulation in buffered areas. Vulnerability to wildfire may also increase as even-aged tree stands grow at the same pace and density. Combine all of these factors with dry weather conditions and hotter, more intense fires can occur.

The purpose of fuel treatments is to reduce the threat of severe wildfire and the negative impacts of intense fire on the riparian environment. But without locally-pertinent data, land managers are unable to provide the documentation needed to support landscape level treatment projects in these areas. As a result, both the effectiveness of fuel treatments and the health of this thriving ecosystem could be compromised. To help address these concerns, researchers sought to determine if fuel treatments reduced the threat of wildfire, to study how fuel treatments including prescribed fire affects riparian vegetation, water quality, biological diversity, and abundance of life, and to gather the data needed to address fuel treatment planning and implementation in southwestern Oregon.

Co-principal Investigator John Alexander stated, "We need to implement ecosystem management and reintroduce the natural fire regime and disturbance processes that forests in this region have evolved under, and we need to monitor the effects of our land management practices on these ecosystems. We can't afford not to do that."

Two watersheds, several indicators

Located in the Middle Rogue Basin in the Klamath Mountain Geological Province of southwestern Oregon, the Upper Applegate Watershed and the Rogue River-Gold Hill watersheds were the specific sites used in this three-year study. Using a paired watershed, before-and-after study design, researchers compared standard fuel treatments applied only to buffered, or upland areas, with a treatment applied to unbuffered, or upland and riparian areas. Non-commercial thinning, and handpiling and burning fuel treatments were used and followed by underburning.

According to Jennifer Smith, Co-principal Investigator, "It was very challenging to find four replicate basins that met the study team and management criteria because study site selection had to be filtered through each conflicting resource and competing land management objectives."

To determine the health of the buffered and unbuffered basins pre and post fuel treatments, researchers used standardized techniques to examine the following key indicators.

Fire behavior: Depending on how a fire burns, fire effects can vary, from fire that is contained to the surface of the forest floor to fires that torch individual trees to running crown fires. Therefore, it is the goal of fuel managers to decrease the fuel load, often through prescribed fire, and thereby decrease the opportunity for more intense crown fires and severe fire effects from wildfire. In addition, by ensuring that wildfire stays on the surface, managers can help promote ecological resiliency in fire-prone habitats.

In this study, researchers compared the predicted fire behavior in buffered and unbuffered basins before and after fuel treatments. High fire season, weather conditions, topography, and crown characteristics were considered to determine if minimizing the fuel load could significantly minimize the threat of wildfire across the landscape.

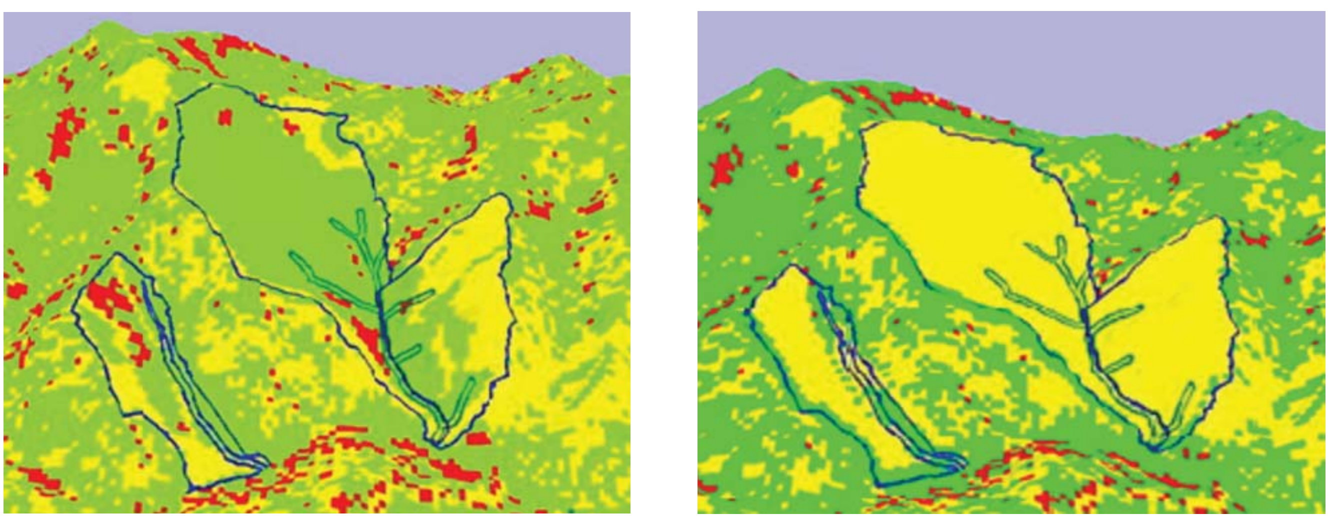
Vegetation: Plants are a vital part of a riparian ecosystem, helping to provide shade and habitat structure, lower stream temperature, stabilize stream banks and nutrient inputs, and filter water by blocking eroded particles from upland areas. Specifically, in southwestern Oregon, many of the native plant species are reliant on fire to promote a variety of ecological processes such as regeneration and nutrient cycling. But treating fuels in these areas can be tricky, as both live and dead vegetation not only provide fuel for wildfires, but provide habitat for terrestrial and aquatic wildlife as well.

Water quality and watershed yield: Vegetation and water go hand-in-hand, especially in a riparian environment. Both terrestrial and aquatic organisms rely on the shade and shelter provided by the riparian vegetation and the cool temperatures and moisture provided by the water. The riparian and hydrologic indicators studied in this project reflect the overall health of aquatic ecosystems and demonstrate responses to disturbance and fuel treatments.

There is speculation that prescribed fire may improve the resiliency of riparian areas, however, fire and fuel managers must exercise caution when treating these areas. Compliance with specific riparian and hydrologic regulations is required and federal land management activities must improve or maintain channel shade as well as sustain sediment levels and stream channel temperature.

Macroinvertebrates: Big enough to be seen with the naked eye, macroinvertebrates are a fundamental part of the freshwater food web, helping break down organic matter such as algae and leaves as well as becoming food for birds and fish. Small but significant, macroinvertebrates are valuable indicators of watershed condition, providing information about stream productivity, water quality, and stress levels. As a result, researchers observed the direct and indirect effects of prescribed fire on macroinvertebrate species composition, richness, diversity and abundance.

Samples of macroinvertebrates such as this stone fly (*Claassenia sabulosa xerces*) were collected at untreated control sites. Credit: Scott Miller.



(Left) Using FlamMap, FARSITE, and Fuels Management Analyst Plus, researchers modeled fire behavior for the unbuffered (outlined in blue on the right) and buffered (outlined in blue on the left) areas before fuel treatments. Yellow represents a surface fire type, green is passive crown fire, and red is active crown fire. (Right) Using the same predictive software models, researchers assessed fire behavior for the unbuffered and buffered areas after fuel treatments. According to the before and after models, fuel treatments helped reduce fire severity in the study basins and unbuffered treatments appeared more successful at reducing the risk of crown fire in both the riparian and upland areas.

Birds: Nesting success, species richness and abundance help indicate how birds may respond to fuel reduction treatments. In the past, fire has been known to help support diverse bird communities in this ecosystem by maintaining mixed-age class forests and creating snags for foraging and nesting. Birds observed in this study included the Black-headed Grosbeak, Western Tanager, Oregon Junco, Cassin's Vireo, and Pacific-slope Flycatcher.

Amphibians: Cool temperatures and moist conditions created by perennial and intermittent stream microclimates are necessary for the survival of amphibians found in the study region. In fact, it appears that amphibians may be particularly sensitive to treatment-related disturbance. Using a literature review, researchers evaluated the potential effects of unbuffered fuel treatments on a variety of amphibian species, including Ensatina, Pacific Giant Salamander, and Siskiyou Mountain Salamander, which were confirmed present during preliminary surveys of the study basins.

Amphibians such as this Ensatina salamander need cool clean water, shade, and dead woody debris to survive. Credit: Chris Brown.

Mixed results

Riparian areas are complex ecosystems, so it's no surprise that this study yielded complicated results. The short research time period, climate variations, and limitations in site selection most likely influenced the study outcomes. Treatment responses varied, making it difficult for researchers to extrapolate results and come to clear conclusions about how riparian areas as a whole respond to fuel treatments. Even so, researchers were able to use their findings to gain a greater understanding of fuel treatment effectiveness and how treatments may affect riparian areas; providing recommendations on treating these areas in the future.

Study results showed that fuel treatments in unbuffered riparian areas helped decrease the predicted intensity of wildfires. Therefore, there is a good chance that this reduction in fire intensity can also help lower burn severity and diminish other potential negative wildfire effects on riparian areas. Researchers also expect that a wildfire in an unbuffered area would be less likely to ignite fires in upland areas or contribute to late summer crown fires. Additionally, it was found that upland treatments alone delayed fire spread to both buffered and unbuffered riparian areas.

Hydrologic, or water-related, indicators were also examined. In unbuffered riparian areas, fuel treatments reduced the understory and subcanopy cover. While most hydrologic indicators remained more or less unchanged, research results suggest that this reduction in understory vegetation could have a negative effect on water temperature in areas with less mature canopies.

Vegetation, macroinvertebrates, birds, and amphibians were also studied. For vegetation, thinning treatments in unbuffered areas appeared to have a negative effect on plant species richness. However, after the underburn treatment in unbuffered areas, species richness increased and was comparable in both unbuffered and buffered areas.

For macroinvertebrate assemblages, little to no adverse effects were measured in both buffered and unbuffered areas.

This ground nesting Oregon Junco is just one of the many bird species that use riparian habitats. Credit: Jim Lavaudais.

Bird species richness did not differ after treatments in buffered and unbuffered zones. The reproductive success of shrub and ground nesting birds did differ, however, with alternate responses after handpile and underburn treatments. Nest success was higher in unbuffered areas after underburning and lower in unbuffered areas after handpiling. Once all treatments were completed, researchers observed a positive trend of nesting success, first stable and then increasing in both buffered and unbuffered basins.

"Birds responded in a biologically meaningful way. This further demonstrates what we've been showing through various fire related research efforts—birds are excellent indicators of ecological change. And so we can use birds as a measuring stick for short- and long-term effects of management actions, including human or natural disturbances on the ground," said Alexander.

For amphibians, negative impacts of unbuffered treatments were limited and site specific. In fact, it appears that unbuffered fuel treatments can help contribute to the long-term survival of amphibians in these areas by reintroducing the fire regime associated with these habitats, encouraging more surface fires and protecting the areas from more severe crown replacing fire.

"Fire and resource specialists inclined to implement these treatments now have reference information available to them regarding the potential short-term effects to a multitude of factors, not limited to fire behavior. This information may also provide decision-makers assurance in supporting resource and fire specialists in a potentially controversial issue," said Smith.

Careful steps forward

For some regions, a one-size-fits-all fuel reduction approach is appropriate. But for the riparian areas of southwestern Oregon, a more site-specific approach is advised. Before treating these areas, researchers suggest evaluating each area on an individual basis. On a landscape scale, it is strongly encouraged that treatments be carefully designed to maintain heterogeneity in habitat structure. Researchers also recommend considering the potential short-term increases in stream temperature that can occur post-treatment. Plus, since some disturbance can increase sedimentation in streams, managers may want to consider the soils and topography of the regions being treated, especially the areas that are prone to erosion. For that reason, it may be beneficial to limit fuel treatments to riparian areas with more overstory shade development and soils that are less likely to erode. These precautions may also help minimize the potential negative impacts of unbuffered fuel treatments on amphibians.

According to Alexander, "This is how ecosystem management should happen. We worked hand-in-hand with the Bureau of Land Management fire managers, district manager, and resource area manager, who totally supported this research all along. And if we didn't have these relationships, it couldn't have happened."

Going forward, it is recommended that fire and fuel managers perform identical fuel treatments within an adaptive management framework. Since there is still much to learn about the riparian ecosystems, researchers also suggest continued monitoring of these study sites, especially when implementing new treatment methods. Researchers would also like to follow up on these study sites in 3 to 5 years, in regular two year intervals after that, and then finally after 10 years. The more managers and researchers know about these complex ecosystems and their responses to fuel treatments over the long term, the greater the chance that the treatment effects will be not only be cost-effective and efficient, but restorative.

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Management Implications

When treating riparian areas, managers should consider:

- Using fire on a limited, case-by-case basis.
- Replicating fuel treatments and continuing long-term monitoring of the study sites.
- Assessing pre-treatment stream temperature to help avoid increasing water temperature.
- Limiting treatments to areas with more overstory shade development and stable soils.
- Retaining large coarse woody debris, shade, and existing stream sedimentation levels to help support and maintain amphibian habitats.
- Identifying shrubs carefully to avoid removing moist-adapted shrubs.

Further Information: Publications and Web Resources

Dejuilio, Jena. 2009. Short-term effects of fuel treatments on vegetation in headwater riparian corridors of the Middle Rogue River Basin in southwest Oregon. Ashland, OR: Southern Oregon University. 87 p. Thesis.

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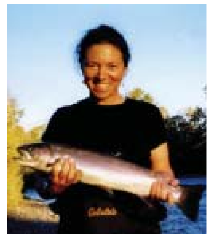
Klamath Bird Observatory Website: http://www.KlamathBird.org

Scientist Profiles



Jennifer Smith has a BS in General Science and Biology from the University of Oregon and an MS in Environmental Studies and Education from Southern Oregon University. A Fish Biologist with the Bureau of Land Management in Medford, OR, Jennifer's primary interest and job focus is on aquatic habitat restoration.

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Co-founder and Executive Director of the Klamath Bird Observatory, **John Alexander** has earned a BS in Field Natural History and Biological Sciences from Evergreen State College, a Master's degree with a biology emphasis in Bird Habitat Relationships in the Klamath Mountains from Southern Oregon University, and is currently pursuing a PhD in Sustainability Education at Prescott College. John's key focus is on developing and testing a conservation implementation strategy, which involves delivering science to land managers through monitoring within an adaptive management framework. By encouraging a collaborative relationship between scientists and land managers, John earned a Best Scientist Manager Partnership Award from the Joint Fire Science Program.

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